Safety Data Sheet

Ethylenimine

Division of Safety
National Institutes
of Health

WARNING!

THIS COMPOUND IS ABSORBED THROUGH THE SKIN AND THE RESPIRATORY AND INTESTINAL TRACTS. IT IS TOXIC AND CARCINOGENIC AND CAUSES SEVERE IRRITATION OF SKIN AND EYES. AVOID FORMATION AND BREATHING OF AEROSOLS OR VAPORS.

LABORATORY OPERATIONS SHOULD BE CONDUCTED IN A FUME HOOD, GLOVE BOX, OR VENTILATED CABINET.

EI IS FLAMMABLE AND EXPLOSIVE. KEEP AWAY FROM SPARKS AND OPEN FLAMES. IN CASE OF FIRE, USE CARBON DIOXIDE OR DRY CHEMICAL EXTINGUISHER.

AVOID SKIN CONTACT: IF EXPOSED, WASH WITH SOAP AND WATER.

FOR EYE EXPOSURE, IRRIGATE IMMEDIATELY WITH LARGE AMOUNTS OF WATER. FOR INGESTION, DRINK WATER OR MILK. FOR INHALATION, REMOVE VICTIM PROMPTLY TO CLEAN AIR. ADMINISTER RESCUE BREATHING IF NECESSARY. REFER TO PHYSICIAN AT ONCE.

IN CASE OF LABORATORY SPILL, WEAR PROTECTIVE CLOTHING DURING CLEANUP. AVOID SKIN CONTACT OR BREATHING OF AEROSOLS OR VAPORS. WASH DOWN AREA WITH WATER. DISPOSE OF WASTE SOLUTIONS AND MATERIALS APPROPRIATELY.

A. Background

Ethylenimine (EI) is a highly toxic, flammable, reactive liquid. It is readily absorbed by the skin, is a severe vesicant, and can cause corneal burns. Sensitization may occur on skin exposure. It is a carcinogen in rodents and a mutagen in cell systems.

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EI is very volatile, and the vapors can explode when exposed to a spark or open flame. A risk of inhalation exists, even when handlin dilute solutions, as the odor does not provide adequate warning.

Chemical and Physical Data

1. Chemical Abstract No.: 151-56-4

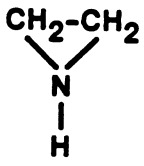
2. Synonyms:

EI	Aminoethylene	Dihydro-1H-azirine
TL337	Azacyclopropane	Dimethylenimine
Azirane	Dihydroazirine	Ethyleneimine
Aziridine (9CI)	Dihydro-1H-aziridine	Ethylimine

3. Molecular formula: C_2H_5N

   weight: 43.07

   structure:



4. Density: 0.832 g/cm^3.

5. Absorption spectroscopy: Data compiled by Dermer and Ham (1969)

6. Volatility: 160 mm at 20°C. The concentration of EI in the saturated vapor at 20°C is 21% (v/v) or 210,000 ppm.

7. Solubility: Miscible with water; soluble in virtually all organic solvents.

8. Description, appearance, and odor: Colorless mobile liquid with strong ammoniacal odor (which does not give adequate warning). Fumes in air.

9. Boiling point: 55-57°C.

   Melting point: -73.96°C.

10. Stability: Thermally stable. Polymerizes rapidly in presence of traces of acid (store over NaOH pellets). Hydrolyzes slowly in aqueous solution. Flammable. Decomposed by UV light.

11. Chemical reactivity: Highly reactive. Ring-opening reactions occurring under acidic conditions can be dangerously violent.

12. Flash point: -11°C.

13. Autoignition temperature: 322°C.

14. Flammable limits: 3 to 50% (v/v).

Fire, Explosion, and Reactivity Hazard Data

1. Use carbon dioxide or dry chemical fire extinguisher. Fire-fighting personnel should wear air-supplied respirators with full-face masks.

2. The explosive range of the vapors is 3 to 50%. The vapors can explode when sparked.

3. Acids, some metals, and chloride ion can catalyze an exothermi polymerization reaction.

4. Incompatible with water. In the presence of acids, copper alloys, and silver alloys, decomposition may be explosive.

5. Nitrogen oxide vapors may be produced on combustion.

6. Do not expose to spark or open flame.

Operational Procedures

The NIH Guidelines for the Laboratory Use of Chemical Carcinogens describe operational practices to be followed when potentially carcinogenic chemicals are used in NIH laboratories. The Guidelines should be consulted to identify the proper use conditions required and specific controls to be implemented during normal and complex operations or manipulations involving EI.

1. Chemical inactivation: No validated method reported.

2. Decontamination: Turn off equipment that could be affected by EI or the materials used for cleanup. If more than 10 ml has been spilled or if there is any uncertainty regarding the procedures to be followed for decontamination, call the NIH Fire Department (dial 116) for assistance. Wash surfaces with copious quantities of water. Glassware should be rinsed (in a hood) with an organic solvent, followed by soap and water. Animal cages should be washed with water.

3. Disposal: No waste streams containing EI shall be disposed of in sinks or general refuse. Surplus EI or chemical waste streams contaminated with EI shall be handled as hazardous chemical waste and disposed of in accordance with the NIH chemical waste disposal system. Nonchemical waste (e.g., animal carcasses and bedding) containing EI shall be handled and packaged for incineration in accordance with the NIH medical-pathological waste disposal system. Potentially infectious waste (e.g., tissue cultures) containing EI shall be disinfected by heat using a standard autoclave treatment and packaged for incineration, as above. Burnable waste (e.g.,

absorbent bench top liners) minimally contaminated with EI shall be handled as potentially infectious waste and packaged for incineration, as above. Absorbent materials (e.g., associated with spill cleanup) grossly contaminated shall be handled in accordance with the chemical waste disposal system. Radioactive waste containing EI shall be handled in accordance with the NIH radioactive waste disposal system.

4. Storage: Store EI stock quantities in a flammable storage cabinet over pellets of NaOH, in screw-capped vials or bottles with Teflon or conical polyethylene liners, or in ampoules.

Monitoring and Measurement Procedures Including Direct Field Measurements and Sampling for Subsequent Laboratory Analysis

1. Sampling: For air sampling, the Drager multi-gas detector (using the hydrazine tube) and the Mine Safety Appliance universal testing kit with EI tube have been evaluated (Dow, 1976). The latter is more accurate but not as fast or as sensitive as the Drager device. Direct air sampling into Folin's reagent with subsequent extraction is an efficient method provided the author's directions are followed exactly (Crompton, 1965). For water sampling, extract with chloroform.

2. Separation and analysis: The most sensitive and rapid method is HPLC, with lower limits of 0.01 ppm in aqueous solution (Evans et al., 1975). Other methods are GC and colorimetry (Crompton, 1965; Epstein et al., 1955).

Biological Effects (Animal and Human)

1. Absorption: EI is rapidly absorbed through animal skin, eyes, and the respiratory and intestinal tracts.

2. Distribution: ^{14}C derived from intraperitoneal administration of labeled EI to rats is found in all tissues except body fat; highest specific activities occur in the liver, gastrointestinal tract, spleen, kidney, and bone marrow (Wright and Rowe, 1967).

3. Metabolism and excretion: Approximately 50% of the ^{14}C label of parenteral or oral EI is excreted in the urine, both as unchanged EI and as its metabolite, monoethanolamine (Wright and Rowe, 1967). Small amounts are excreted in the feces and in expired air (both as unchanged EI and as $^{14}CO_2$). Much of the remainder appears to react with and be bound to macromolecules (DNA, RNA, proteins), and this reaction is probably responsible for the cytotoxic effectiveness of EI.

4. Toxic effects:

   a. Animals

      LD50s for EI are 15 mg/kg (rat, oral), 3.8 mg/kg (rat,

intraperitoneal), and 14 mg/kg (guinea pig, skin); the lowest lethal inhalation dose is 25 ppm over an 8-hour period (rat, guinea pig). In guinea pigs, inhalation of 50 ppm for 6 hours or 100 ppm for 4 hours is fatal.

The chief target organs for toxic effects in animals are kidney (necrosis, malfunction such as diuresis and albuminuria), testes, and bone marrow. EI is a powerful irritant of skin (necrosis, vesication) and the respiratory tract (lung congestion, edema, and hemorrhage, often delayed). Skin sensitization has been noted.

b. Humans

Accidental exposures have led to transient albuminuria and severe irritation of the nasopharynx (Weightman and Hoyle, 1964).

5. Carcinogenic effects: EI administration (feeding to rats, subcutaneous to mice) produces a high incidence of malignancies (hepatomas and pulmonary tumors).

6. Mutagenic and teratogenic effects: While EI is highly mutagenic in plants, bacterial systems, and fruit flies, no mutagenicity has been noted in mammals or in humans engaged in EI production (Stokinger, 1974). However, studies with human cell cultures do indicate mutagenicity; therefore, EI should be regarded as at least a potential mutagen. There is also some indication of embryotoxicity in rats but none of teratogenicity.

Emergency Treatment

1. Skin and eye exposure: For skin exposure, remove contaminated clothing and wash skin with soap and water for 15-30 minutes; burns may be delayed several hours. For eye exposure, irrigate immediately with copious quantities of running water for at least 15 minutes. Obtain ophthalmological evaluation.

2. Ingestion: Drink plenty of water or milk.

3. Inhalation: Remove victim promptly to clean air. Administer rescue breathing if necessary. Inhalation or ingestion may produce nausea, vomiting, cough, and lung irritation. Symptoms may be delayed. Exposure with or without symptoms requires hospitalization for observation and treatment. Difficulty in breathing requires oxygen on the way to the hospital.

4. Refer to a physician at once.

References

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